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85. Proposed by E. W. MORRELL, A. M., Professor of Mathematics, Montpelier Seminary, Montpelier, Vt.

In turning a one-horse chaise within a ring of a certain diameter, it was observed that the outer wheel made two turns, while the inner wheel made but one. The wheels were each 4 feet high; and supposing them fixed at the distance of 5 feet on the axletree, what was the circumference of the track described by the outer wheel? From *Greenleaf's National Arithmetic.*

Solution by EDWIN R. ROBBINS, Master of Mathematics, Lawrenceville School, Lawrenceville, N. J.

Let r=radius, then $2\pi r$=circumference of inner track.
$r+5$=radius, then $2\pi(r+5)$=circumference of outer track.
From problem, $2(2\pi r)=2\pi(r+5)$, whence $r=5$.
Hence, outer track$=20\pi=62.83184+$ feet.

Also solved by *J. SCHEFFER*, *G. B. M. ZERR*, *F. R. HONEY*, *CHARLES C. CROSS*, *LEE WILCOX*, and *P. S. BERG*.

86. Proposed by EDGAR H. JOHNSON, Professor of Mathematics, Emory College, Oxford, Ga.

$$\tfrac{1}{7}=.\dot{1}4285\dot{7}\ ;\ \tfrac{1}{11}=.\dot{0}\dot{9}\ ;\ \tfrac{1}{13}=.\dot{0}7692\dot{3}\ ;\ \tfrac{1}{17}=.\dot{0}5882359411764\dot{7}.$$

Observe that if the numbers forming the first half of the repetend be added respectively to the numbers forming the second half of the repetend, the sum is in every case 9. What is the general law of which these are special cases?

I. Solution by O. W. ANTHONY, M. Sc. Instructor in Mathematics in Boys' High School, New York City.

Put $\dfrac{1}{x}=\dfrac{R}{10^n}\left[1+\dfrac{1}{10^n}+\dfrac{1}{10^{2n}}+\dfrac{1}{10^{2n}}+\text{ etc.}\right]$, where R is the sequence of digits in the repetend and u the number of digits.

Call R_1 the first half of the repetend expressed in whole numbers, and R_2 the second half.

Then $R_1+R_2=999\ldots\ldots=10^{\frac{1}{2}n}-1$.

Also $R=10^{\frac{1}{2}n}R_1+R_2,\ =10^{\frac{1}{2}n}R_1-R_1+10^{\frac{1}{2}n}-1,\ =(10^{\frac{1}{2}n}-1)(R_1+1)$.

$$\therefore\ \frac{1}{x}=\frac{(10^{\frac{1}{2}n}-1)(R_1+1)}{10^n}\cdot\frac{10^n}{10^n-1},\ \text{ or } x=\frac{10^{\frac{1}{2}n}+1}{R_1+1}.$$

This gives the law of formation when the first part of the repetend is R_1.

Then, if $R_1=142$, $x=\dfrac{10^3+1}{143}=7$.

To find all repetends of six figures obeying the law, we proceed as follows:

$x=\dfrac{10^3+1}{R_1+1}=\dfrac{1001}{R_1+1}=\dfrac{13\times11\times7}{R_1+1}$. We must select such values for R_1 as will give x integral values.

If $R_1=12$, $x=77$.
If $R_1=10$, $x=9$.
If $R_1=6$, $x=143$.
If $R_1=76$, $x=13$.
If $R_1=142$, $x=7$.